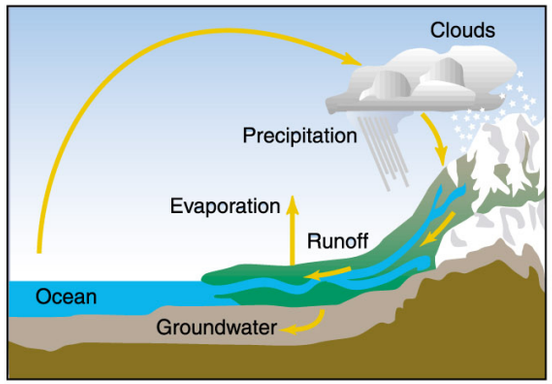
How Hydropower Works...

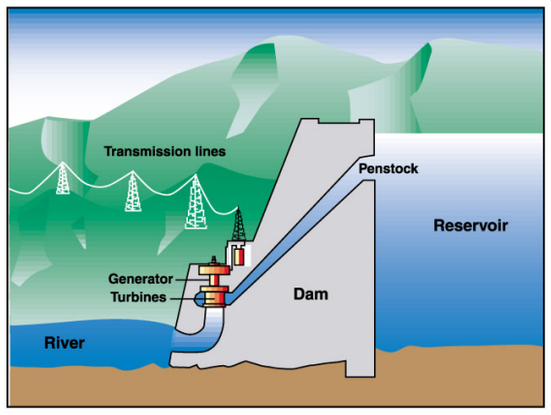
The Hydrologic Cycle

Water moves constantly through a vast global cycle. It (a) evaporates from the land, lakes, streams, and oceans, (b) forms clouds, (c) precipitates as rain or snow; and then (d) flows back to the ocean. The energy of this water cycle, which is driven by the sun, is tapped most efficiently with hydropower.

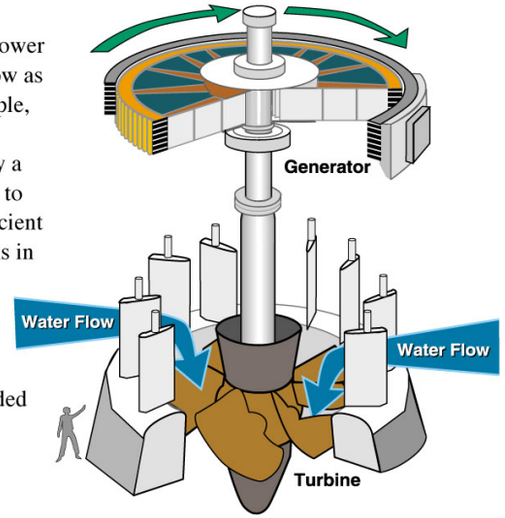


Generating Electricity

Hydropower plants capture the energy of falling water to generate electricity. A dam impounds water to form a reservoir and raises the water level to create head. Head is the vertical distance the water falls as it passes through the dam (i.e., the difference in water level between the reservoir and the river below the powerplant). The water is directed through penstocks to turbines, which drive generators to produce electric power.



Just having water in the river isn't enough. A good hydropower site must have enough streamflow as well as enough head. For example, the Mississippi River has tremendous streamflow, but only a few of its dams are high enough to provide the head needed for efficient hydropower development. Dams in the arid West may have plenty of head, but not enough streamflow. Where the right combination of streamflow and head exists, the Corps has included powerplants at its dams.



Hydropower Project Operation

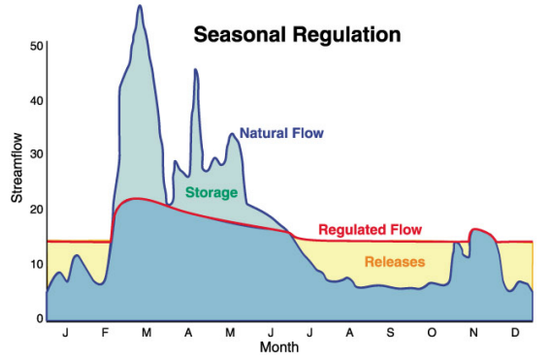
Corps of Engineers projects with hydropower generating facilities fall into two categories: storage projects and run-of-river projects.

Storage projects are usually located in the headwaters of river basins. Their purpose is to more evenly distribute the streamflow they release over the course of the year. In nature, river flow fluctuates widely. Streamflow is typically high during the rainy season and low in late summer and fall. In semi-arid regions, rivers become nearly dry in autumn. In many of the western river basins, flows remain low all winter as snow accumulates in the mountains and then swell with snowmelt in the spring.

Storage reservoirs capture river flow during the high runoff season and release it during dry periods. This creates a more dependable year-around flow for generating power. Keeping flows higher during the dry season also benefits other downstream river uses, like navigation, fisheries, recreation, water quality, and municipal water supply. Also, capturing part of the runoff during high flow periods helps reduce flood damage downstream. In fact, flood damage reduction is one of the major purposes of all Corps storage projects.

Allatoona seasonal storage project (GA)

Because storage projects follow a seasonal pattern of releasing water during dry periods and refilling in the high runoff season, water levels in the reservoirs behind dams fluctuate. They are usually full in early summer, but once the dry season begins, there is a gradual drawdown. Since reservoir recreation is an important project use, the Corps keeps reservoir levels as high as possible during the summer. However, droughts may keep reservoirs from filling in the spring or may force the drawdown to start before or during the recreation season.



The other major type of dam is the run-of-river project. It has little or no storage. The most common example of a Corps run-of-river project is the navigation lock and dam. Its purpose is to raise the river level to provide enough depth for commercial navigation. Such dams would typically be located on the lower reaches of a navigable river. Some lock-and-dam projects have a small amount of storage, called pondage. This is used to regulate powerhouse flow so that most of the generation is produced in the hours of peak power demand. Other lock-and-dam projects have no storage at all. They pass inflows straight through without any regulation.

Cordell Hull Lock and Dam, a run-of-river project (TN)

River basins like the Arkansas, Missouri, Columbia, and Cumberland have storage projects in the headwaters and run-of-river projects in the lower reaches. These projects operate together as a system. During the low flow season, the storage projects release water to increase downstream flows, some or all of which are used to increase power generation at downstream run-of-river projects. Power generation is only one of the objectives of these storage reservoirs, and careful management is required to ensure that all project purposes are served successfully.